

Joule's Law

$$H = I^2 R t$$

H = heat I = current

R = resistance t = time

Ideal Electrode Material

- Perfect Conductor of Electricity
- Perfect Conductor of Heat
- Conform to Any Shape
- Resist Any Forging Force
- Inexpensive
- Long Electrode Life

Electrode material

CLASS 1

High conductivity
Least hard of RWMA
classes

Properties

Low surface
resistance
modest strength

Material to be Welded

Aluminum, galvanized steel,
brass, bronze, zinc-rich
primers, magnesium alloys,
tin plate, aluminized and
other coated steel

CLASS 2

Med. conductivity
and hardness

Medium resistance
and hardness

Mild steel, low alloy steel,
galvanized steel, monel,
titanium, low conductivity
brass and bronze

CLASS 3

Low conductivity
high hardness

High heat and
pressure
resistance

Stainless steel, projection
welding and hot upsetting

CLASS 20

Med. Conductivity
and hardness

Medium resistance
and hardness

Coated metals - galvanized
steel, terne plate, etc.

TROUBLESHOOTING RESISTANCE WELDING

This chart is intended only as a check list of the possible causes of some of the more common weld defects. The data shown should be used only as a guide and applies basically to two equal thicknesses of mild steel.

AREA OF CAUSE	POSSIBLE CAUSE OF WELD DEFECT	TYPE OF DEFECT							
		EXPULSION AT WELD INTERFACE	SURFACE EXPULSION ELECTRODE STICKING	ELECTRODE MUSHROOM	LOW WELD STRENGTH	EXCESSIVE WELD INDENTATION	INTERNAL CRACKS IN WELD NUGGET	CRACKS IN PARENT METAL	DISPLACED WELD NUGGET
WELDING CONDITIONS	SQUEEZE TIME-Short	X	X						
	WELD TIME	Short				X			
		Long		X	X		X	✓	
	HOLD TIME - Short		X		✓		X	✓	
	WELD FORCE	Low	X	X	X		✓	X	
		High			✓	X	X		X
	WELD CURRENT	Low				X			
		High	✓	X	X		X		
	ELECTRODE FACE AREA	Small			X	X	✓		✓
		Large				✓		✓	
WELDING ELECTRODES	ELECTRODES MISALIGNED		✓					X	
	INSUFFICIENT COOLING			X		✓		X	
	POOR HEAT BALANCE		✓		X			X	
	CONDUCTIVITY ELECTRODE MATL	Low		✓	✓				✓
High								✓	
PARTS WELDED	DIRTY-SCALEY MATERIAL	X	X		✓		X		
	POOR FIT UP	X			✓	X		X	
	INSUFFICIENT EDGE DISTANCE	X	✓		✓	✓			
	WELDS TOO CLOSE TOGETHER				X				
	METALLURGY OF MATERIAL WELDED	✓	✓		✓	✓	X	X	
MISC.	POOR HEAD FOLLOW UP	✓	✓			✓	X		
	WELDER HEAD IMPACTS WORK			X		X			
	POOR VOLTAGE REGULATION	✓	✓						
	POOR AIR PRESSURE REGULATION	✓	✓						

Note: Causes considered Individually

X = MORE PREVALENT ✓ = LESS PREVALENT

Expulsion at Weld Interface



Most Common Causes

1. Short Squeeze Time
2. Low Weld Force
3. Dirty – Scaley Material
4. Poor Fit Up
5. Insufficient Edge Distance

Less Prevalent Causes

1. High Weld Current
2. Metallurgy of Material Welded
3. Poor Head Follow-up
4. Poor Voltage Regulation
5. Poor Air Pressure Regulation

Surface Expulsion/Electrode Sticking



Most Common Causes

1. Short Squeeze Time
2. Long Weld Time
3. Short Hold Time
4. Low Weld Force
5. High Weld Current
6. Dirty – Scaly Material

Less Prevalent Causes

1. Electrodes Misaligned
2. Poor Heat Balance
3. Low Conductivity of Electrode Material
4. Insufficient Edge Distance
5. Metallurgy of Material Welded
6. Poor Head Follow-up
7. Poor Voltage Regulation
8. Poor Air Pressure Regulation
9. Poor Water Flow

Electrode Mushroom



Most Common Causes

1. Insufficient Cooling
2. Low Weld Force
3. High Weld Current
4. Small Electrode Face Area
5. Long Weld Time
6. Welder Head Impacts Work

Less Prevalent Causes

1. High Weld Force
2. Low Conductivity of Electrode Material

Low Weld Strength



Most Common Causes

1. Short Weld Time
2. Low Weld Force
3. Low Weld Current
4. Small Electrode Face Area
5. Poor Heat Balance
6. Welds Too Close Together

Least Prevalent Causes

1. Short Hold Time
2. Large Electrode Face Area
3. High Conductivity of Electrode Material
4. Dirty-Scaly Material
5. Poor Fit Up
6. Insufficient Edge Distance
7. Metallurgy of Material Welded
8. High Weld Force

Excessive Weld Indentation



Most Common Causes

1. Long Weld Time
2. High Weld Force
3. High Weld Current
4. Poor Fit Up
5. Welder Head Impacts Work

Less Prevalent Causes

1. Low Weld Force
2. Small Electrode Face Area
3. Insufficient Cooling
4. Insufficient Edge Distance
5. Metallurgy of Material Welded
6. Poor Head Follow-up

Internal Cracks in Weld Nugget



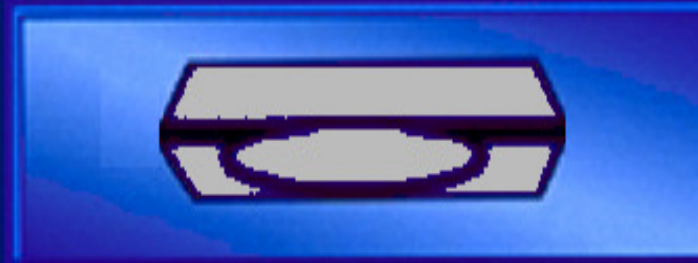
Most Common Causes

1. Short Hold Time
2. Low Weld Force
3. Dirty–Scaley Material
4. Metallurgy of Material Welded
5. Poor Head Follow Up

Less Prevalent Causes

1. Small Electrode Face Area
2. Long Weld Time

Displaced Weld Nugget



Most Common Causes

1. Electrodes Misaligned
2. Poor Heat Balance
3. Poor Fit Up

Less Prevalent Causes

1. Low Conductivity of Electrode Material
2. High Conductivity of Electrode Material

Cracks in Parent Material



Most Common Causes

1. High Weld Force
2. Insufficient Cooling
3. Metallurgy of Material Welded

Less Prevalent Causes

1. Small Electrode Face Area
2. Short Hold Time